Title of Invention

RADIAL REACTOR LOADING

Cross Reference to Related Applications

~~None~~ This application is a continuation-in-part application based on application Serial No. 09/727,036, filed on Nov. 30, 2000.

Background of Invention

1. Field of Invention.

The field of art to which this invention pertains is to the composition of a catalyst bed contained in a radial reactor, wherein the catalyst bed includes catalyst material and an inert material. More particularly, this invention relates to a catalyst bed for a radial reactor for dehydrogenation reactions, wherein the catalyst bed is divided into an inner and an outer ring-shaped, vertical layer, wherein catalyst material is contained in the outer vertical layer and an inert material is contained in the inner, vertical layer.

2. Description of related art.

Radial reactors are utilized for a number of different types of catalytic reactions. For example, radial reactors are utilized in ammonia synthesis plants as disclosed in U.S. Patent Nos. 4,880,603 and 5,250,270.

Various designs for radial reactors and the flow pattern of feed streams within those radial reactors have been disclosed in a number of patents owned by Ammonia Casale S.A. The reactions that occur in those radial reactors are generally heterogenous synthesis reactions,

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REMARKS/ARGUMENTS

Claims 23-50 **[You dictated "23-51"]** remain in the application. Claims 24-48 as filed have been amended and renumbered as Claims 23-47. Claims 23 and 41 have been otherwise amended. Claim 40 has been amended to correct an inconsistency in that claim and to place it in independent form.

The USPTO has rejected most of the claims of the application based on U.S. Patent No. 5,580,770 (DeFilippi) alone or in combination with Reischl, et al., U.S. Patent No. 4,576,718. Additional claims have also been rejected by the United States Patent and Trademark Office based on these two references and further in view of Williamson, U.S. Patent No. 5,022,993, Parker, et al., U.S. Patent No. 5,518,910, Yoda, et al., JP 407068286A and Fuchs, U.S. Patent No. 4,715,958. The applicant respectfully traverses each of these rejections.

The USPTO first objects to the claims of the application, stating that the phrase "highly loaded with ammonium" is indefinite. While the applicant believes that the phrase "highly loaded" is a well accepted phrase in the industry, in order to overcome this rejection the applicant has introduced into Claim 1 **[?]** a requirement that the ammonium be present in the industrial waste water "at a level of at least about 200 mg/liter." As pointed out by the Examiner, the lower limitation which is

contained in Claim 26 is now introduced into Claim 23 by this amendment.

DeFilippi (U.S. Patent No. 5,580,770)

DeFilippi forms the primary basis for the rejection of the claims of the application. DeFilippi discloses an adsorbent coated support for use in biological processes for the purification of waste streams. (Column 1, lines 20-21, column 3, lines 60-62) The support according to DeFilippi comprises a substrate, having applied thereto at least in part a coating composition comprising an effective amount of at least one adsorbent, at least one binder, an effective amount of at least one suspension aid and a solvent. In contrast, the present invention is directed to a process for treating industrial waste water wherein a silicate carrier substance is directly suspended in the waste water. Such carrier substances are not treated with a coating composition or a binder or an effective amount of a suspension aid. Rather, the carrier substance of the present invention due to its direct suspension and the waste water and its defined properties as claimed is completely available to the nitrifying organisms and provide by themselves a surprisingly efficient support for those microorganisms. This approach is completely different from the approach taken by DeFilippi, i.e., having a support coated with a water insoluble binder comprising adsorbent particles. (See Column 8, lines 62-65)

The Examiner cites Column 10, lines 35-42, Column 12, lines 22-26 and Column 17, lines 46-49 to support the view that this reference discloses the invention. The reference to ceramics such as bentonite, etc. at Column 10, lines 35-42 merely discloses the substrate material which forms only a part of the composite support of the material of DeFilippi.

To understand DeFilippi it is important to understand the invention that is disclosed therein. As stated in the abstract, the invention is "A biologically active support for removing pollutants from a fluid stream ...". This support is "formed of a polymeric foam substrate coated with a composition containing a particulate adsorbent which adsorbs, then releases pollutants, and a polymeric binder that binds the adsorbent to the surface of the substrate. The binder contains a suspension aid, and one or more pollutant-degrading microorganisms are adhered to the surface of the coated support." Thus, the invention of DeFilippi requires the following components: (a) a substrate, (b) a particulate adsorbent, (c) a polymeric binder that binds the adsorbent to the surface of the substrate. The binder contains (d) a suspension aid and alternatively (e) one or more microorganisms. The structure of this composition is well shown in Figures 4A and 4B which again sets forth the three major components of the invention of DeFilippi: a substrate, an adsorbent and a binder. (Note that these drawings do not even include the microorganism that is required to

be included to disclose the applicant's invention.) The concept the DeFilippi invention requires at least these three components, i.e., a foam substrate, a binder and an adsorbent bound to the substrate by the binder, is disclosed throughout the patent. (See Column 1, lines 26-30, Column 4, lines 25-37, Column 13, line 60 through Column 14, line 2, each of the Examples.) See also Claim 1 of DeFilippi which claims a biologically active support comprised of "a coated support", "an adsorbent", at least "one polymeric binder" and "a microorganism adhered to the surface of the coated support." Any composition that did not require the presence of each of these three or four components is not disclosed by DeFilippi. In contrast, the applicant's invention as claimed requires the presence of a silicate carrier substance which is suspended in the waste water along with nitrifying microorganisms. There is no requirement of a binder to bind a particulate adsorbent to a support mechanism. There is no requirement of a suspension aid.

The Examiner's reference to selections from DeFilippi which mention a ceramic material merely discuss elements that could form the substrate for the DeFilippi material and do not describe the invention as claimed.

In summary, DeFilippi takes a totally different approach to the treatment of waste water. DeFilippi teaches that you must prepare a substrate material and bind to that substrate material an

adsorbent by use of a polymeric binder and preferably include in that binder a suspension aid and a microorganism. This composition is best shown in Figures 3, 4A and 4B of DeFilippi. In contrast, the applicant's invention teaches the use of directly suspended silicate carrier substances which are placed within the waste water and form the optimal support for the nitrifying microorganisms which are used to treat the waste water.

Reischl, et al (U.S. Patent No. 4,576,718)

The Examiner acknowledges that DeFilippi fails to disclose the swellability of the carrier and cites Reischl, et al. for this proposition. Reischl, et al. is concerned with the use of water absorbing highly-filled polyurethane compositions for biological treatment of waste-containing liquid. Reischl, et al. teaches that a large number of fillers may be used, as disclosed in Columns 4 and 5. The Examiner cites Column 5, lines 29-45 and Column 6, lines 44-61 to support his view that the reference discloses silicate carriers having a solubility within the range as claimed. In fact, this reference states that inorganic fillers are preferably added in addition to the fossil and/or foam fillers in proportion to permit a certain control of the specific weight of the carriers so that they sink or are suspended in the liquid to be treated but do not float on it. It is clear to a person skilled in the art that the carrier without the inorganic fillers has a lower

specific weight than water and would float. Therefore, inorganic fillers with a higher specific weight, i.e., those which will rapidly sink in water may be added to balance the weight of the filled carrier in such a way that they will sink or at least are suspended in the liquid to be treated. In fact, the inorganic fillers are used as weights to avoid floating of the polyurethane carriers. Note also at Column 6, lines 44-61 that the water absorbing properties that are described relate to the polyurethane (urea) carrier compositions, not the fillers as such, which are used as weights according to Column 5, lines 29-44. Column 6, lines 44-61 merely state that water absorbing properties can be introduced by means of hydrophilic polyurethane (urea) and/or by hydrophilic fillers. There is no mention whether the water adsorbents leads to any swelling of the filler as such or waters merely adsorbed in a porous structure.

Notwithstanding, even a combination of DeFilippi and Reischl, et al. for which there is no suggestion of combination, would not lead to the claimed invention. A person skilled in the art combining the teaching of DeFilippi with Reischl, et al. would still use a polymer matrix carrier comprising down adsorbent particles and not directly suspended silica carrier particles as claimed in the application.

Parker, et al. (U.S. Patent No. 5,518,910); Yoda, et al. (JP 407068286A) and Fuchs (U.S. patent No. 4,715,958)

Each of these references are combined with DeFilippi and Reischl, et al. to disclose some aspect of the dependent claims. As DeFilippi alone or in combination with Reischl, et al. do not disclose the invention as claimed in independent Claim 23, none of the combinations with these alternative references teach the invention as claimed in the cited dependent claims.

In particular, certain of the dependent claims are not disclosed by any of the references. For example, Claim 25 which states that 95 percent of the silicate carrier substances have a particle size less than 150 μm is clearly not disclosed by any of the references. This relatively small particle size and the swelling capability of silicate carriers insure that the carrier substance remains suspended. In contrast, DeFilippi uses much larger composite carriers filled or coated with various adsorbents, the size of which is shown, for example, in Figures 3, 4A and 4B.

The applicant asserts that the invention is clearly not disclosed by DeFilippi alone or in combination with any of the other cited references and requests that the rejections based on these references be withdrawn.

CONCLUSION

The applicant believes that all claims are now in condition for allowance and requests a notice of such allowance. If there

are any additional issues relating to this matter, please contact applicant's counsel.

Respectfully submitted,

Scott R. Cox
Reg. No. 31,945
LYNCH, COX, GILMAN & MAHAN, P.S.C.
400 West Market Street, Suite 2200
Louisville, Kentucky 40202
(502) 589-4215

CERTIFICATE OF SERVICE

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

Claims 24-48 have been amended as follows:

(Amended) ~~24.~~ 23. A process for treating industrial waste water which is highly loaded with ammonium at a level of at least about 200 mg/liter comprising treating the waste water with nitrifying microorganisms ~~which are~~ in the presence of suspended silicate carrier substance, wherein the silicate carrier substance has a specific surface area greater than about 20 m^2/g, wherein the silicate carrier substance has a ~~sweeling~~ swelling volume of about 5 to about 80 ~~m^2/g~~ ml/2g, wherein the carrier substance acts as a carrier for the nitrifying microorganisms and wherein the silicate carrier substance with the nitrifying microorganisms is suspended in the waste water~~, and~~

~~denitrifying the nitrified waste water with denitrifying organisms~~.

(Amended) ~~25.~~ 24. The process of Claim ~~24~~ 23, wherein the specific surface area of the carrier substance is greater than about 50 m^2/g.

(Amended) ~~26.~~ 25. The process of Claim ~~24~~ 23, wherein at least 95 percent of the silicate carrier substance has a particle size less than about 150 μm.

(Amended) ~~27.~~ 26. The process of Claim ~~24~~ 23, wherein the industrial waste water has an ammonium / nitrogen content of about 200 to 2000 mg/liter.

(Amended) ~~28.~~ 27. The process of Claim ~~24~~ 23, wherein the industrial waste water has an ammonium / nitrogen content of about 400 to 1600 mg/liter.

(Amended) ~~29.~~ 28. The process of Claim ~~24~~ 23, wherein a source of the waste water is selected from the group consisting of flow from a sludge treatment plant, supernatant water from sludge digestion and waste dump leakage water.

(Amended) ~~30.~~ 29. The process of Claim ~~24~~ 23, further comprising impregnating the silicate carrier substance with the nitrifying microorganisms prior to its addition to the waste water.

(Amended) ~~31.~~ 30. The process according to Claim ~~24~~ 23, wherein the denitrifying process is carried out under anoxic conditions.

(Amended) ~~32.~~ 31. The process of Claim ~~24~~ 23, wherein the silicate carrier substance comprises about 5 to 50 grams per liter of the waste water.

(Amended) ~~33.~~ 32. The process according to Claim ~~24~~ 23, wherein the silicate carrier substance has a surface pH of about 6 to 9.

(Amended) ~~34.~~ 33. The process of Claim ~~24~~ 23, wherein the silicate carrier substance comprises a clay mineral.

(Amended) ~~35.~~ 34. The process of Claim ~~24~~ 23, wherein the clay mineral comprises a smectite clay.

(Amended) ~~36.~~ 35. The process of Claim ~~24~~ 23, wherein during treatment with the nitrifying microorganisms, the pH value of the waste water is adjusted to about 6.5 to about 8.5 by the addition of an alkali material.

(Amended) ~~37.~~ 36. The process of Claim ~~24~~ 23, wherein the amount of the silicate carrier substance added to the waste water is from about 6 to about 15 kg per kg of nitrogen in the waste water.

(Amended) ~~38.~~ 37. The process of Claim ~~24~~ 23, wherein the nitrifying process is carried out under aerobic conditions.

(Amended) ~~39.~~ 38. The process Claim ~~24~~ 23 further comprising nitrifying the waste water by introducing an oxygen-containing gas to the waste water.

(Amended) ~~40.~~ 39. The process of Claim ~~39~~ 38, wherein the oxygen content of the waste water is adjusted to be at least about 2 mg per liter of waste water.

~~41. The process of Claim 24, wherein the silicate carrier substance is a carbon-containing material selected from the group consisting of activated charcoal, lignite, coke, coke dust, anthracite, graphite and carbon black.~~

(Amended) ~~42.~~ 41. The process of Claim ~~41~~ 40, wherein the surface pH of the ~~waste water~~ carbon-containing material is adjusted to a pH from about 6.5 to about 8.

(Amended) ~~43.~~ 42. The process of Claim ~~24~~ 23, further comprising adjusting the nitrogen content of the waste water to a volumetric loading of about 0.5 to about 2.5 kg of ammonium nitrogen per m^3 waste water.

(Amended) ~~44.~~ 43. The process of Claim ~~24~~ 23, further comprising reducing the Chemical Oxygen Demand level from at least about 300 to about 100 mg/liter before the nitrification process.

(Amended) ~~45.~~ 44. The process of Claim ~~24~~ 23, wherein the NH_4 / nitrogen content is limited to a maximum value of about 1200 mg/liter before the nitrification process.

(Amended) ~~46.~~ 45. Process of Claim ~~24~~ 23, wherein the nitrifying microorganisms comprise ammonium-oxidizing bacteria.

(Amended) ~~47.~~ 46. Process of Claim ~~30~~ 29, wherein a source for the denitrifying microorganisms comprises a carbon-based product.

(Amended) ~~48.~~ 47. The process of Claim ~~34~~ 33, wherein the clay mineral comprises a bentonite clay.

New Claims 40, 48-50 have been added as follows:

40. A process for treating industrial waste water which is highly loaded with ammonium comprising treating the waste water with nitrifying microorganisms which are in the presence of suspended carbon-containing material, wherein the carbon-containing

material is selected from the group consisting of activated charcoal, lignite, coke, coke dust, anthracite, graphite and carbon black wherein the carbon-containing material acts as a carrier for the denitrifying microorganisms and wherein the carbon containing material with the denitrifying microorganisms is suspended in the waste water, and

denitrifying the nitrified waste water with denitrifying organisms.

48. The process according to Claim 23 wherein the silicate carrier substance has a cation exchange capacity (CEC) of about 40 to 100 mVal/100 g.

49. The process according to Claim 23 wherein the silicate carrier substance has a cation exchange capacity (CEC) of about 50 to 80 mVal/100 g.

50. The process of Claim 23 wherein the swelling volume of the silicate carrier substance is from about 10 to about 20 ml/2g.

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